REMARKS

Original claims 1-6 and 12-20 remain in this application; claims 1-6 have been amended and claim 21 has been added by this Amendment. Claims 7-11 have been withdrawn by the Examiner as being directed to a non-elected invention. Applicant hereby confirms the provisional election of Group I (claims 1-6 and 12-20) with traverse. Applicant has made the foregoing amendments to the specification to correct various typographical errors.

In the subject Office Action, the Examiner rejected all of the pending claims on various grounds. Applicant respectfully requests reconsideration for the reasons set forth below.

With respect to claims 1-6, neither Davis et al. nor Barton et al. nor any other art of record, individually or in combination, teaches, discloses, or suggests an inflatable heating device in which a flexible matrix is cured to a stable elastomeric state by electrical resistive heating of nonmetallic, electrically conductive fibers embedded within the flexible matrix as recited in independent claim 1. Therefore, claim 1 is allowable over the art of record, and claims 2-6 are allowable because they depend from claim 1. Claim 1 has been broadened to recite "nonmetallic, electrically conductive fibers" rather than specifically carbon fibers, which is supported in the specification at page 8, lines 4-7 and page 19, lines 22 & 25. Claim 1 has also been broadened by deleting the recitation of "said carbon fibers arranged helically and positioned at an angle with respect to the longitudinal axis of said body." Although such a helical arrangement is preferred, the invention is not limited to such an arrangement. The recitation of the flexible matrix being cured to a stable elastomeric state by electrical resistive heating of the embedded fibers is supported in the specification at page 4, lines 25-27; page 5, lines 28-30; page 6, lines 4-6; page 7, lines 17-20; page 8, lines 13-15; and page 19, lines 17-19 and 22-26. In view of the electrical resistive heat cure limitation, which is consistent with the process claims, it is respectfully

submitted that the restriction requirement is inappropriate, and Applicant requests that claims 7-11 be reinstated. Claim 2 has been broadened to include the subject matter originally recited in claim 3, and claim 3 has been broadened to include various types of nonmetallic, electrically conductive fibers disclosed in the specification. Claim 4 has been amended to remove the carbon limitation to be consistent with claim 1 and to include the helical limitation which was removed from claim 1. Claims 5 and 6 have been broadened by deleting the carbon limitation consistent with the changes to claim 1, and claim 6 has also been broadened by replacing the words "are in the form of" with the word "comprise." Claim 21 is directed to a preferred embodiment of the disclosed invention which contains helically arranged carbon fibers as the electrically conductive heating element.

With respect to the rejection of claim 17 under 35 U.S.C. § 112, second paragraph, and the objection to claim 17 under 37 C.F.R. 1.75(c), Applicant respectfully submits that such rejection and objection are improper because claim 17 does particularly point out and distinctly claim the subject matter which Applicant regards as his invention, and claim 17 does provide a further limitation on its parent claim 12. Specifically, claim 17 recites a pre-preg (which is not recited in claim 12) removably attached to an outer surface of the composite (which is recited in claim 12). Therefore, Applicant respectfully requests that the Examiner withdraw such rejection and objection.

The remaining rejections are all based on, among other things, an alleged teaching and combination of Japan '323 and Japan '334. However, neither Japan '323 nor Japan '334 nor any other art of record, alone or in combination, teaches, discloses, or suggests an apparatus or a method that includes an inflatable composite comprising a heating element disposed within a thermoset resin matrix as recited in independent claims 12 and 20, respectively. Although Japan

'323 discloses a heater tube that is used to cure a thermosetting resin of a tube lining repair material, Japan '323 does not appear to disclose the composition of the heater tube or suggest that the heater tube should comprise a heating element disposed within a thermoset resin matrix. Likewise, although Japan '334 discloses a cylindrical cloth that is heated to cure an adhesive of a repair sleeve that is positioned outside of the cloth, Japan '334 does not appear to disclose the composition of the cloth or suggest that the cloth should be embedded within a thermoset resin matrix. Moreover, none of the art of record recognizes the significant advantage achieved by Applicant's invention of being able to use the electrically conductive heating element both to cure the inflatable composite body itself and to subsequently cure the pre-preg repair piece. In light of the foregoing, independent claims 12 and 20 are allowable over the art of record, and claims 13-19 are allowable as depending from claim 12.

Additionally, with respect to claims 14-16, Baker et al. discloses a braided steel wire used as reinforcement in a downhole packer; Baker contains no teaching or suggestion of braided nonmetallic fibers used as a heating element in a repair bladder. Therefore, Baker et al. is not properly combinable with Japan '334 as argued by the Examiner.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The marked-up version is captioned "Version with Markings to Show Changes Made."

In view of the foregoing, Applicant respectfully requests that a timely Notice of Allowance be issued in this application. If the Examiner believes that a telephone conference would advance the prosecution of this application, the Examiner is respectfully requested to contact the undersigned attorney.

Applicant encloses a check in the amount of $511.00 to cover the extra claim fees ($51.00) and the enclosed Petition for Extension of Time ($460.00) as a small entity. The Commissioner is hereby authorized to charge any deficiency in fees or credit any overpayment to Deposit Account No. 502248.

Respectfully submitted,

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Version with Markings to Show Changes Made

In the Specification:

At page 2, line 10, the paragraph beginning with "In the past" (which continues to page 3, line 2) has been amended as follows:

> In the past, flexible heaters have been produced using ferrous or metallic wires within the composition to provide heat by resistive means. While these wires are an efficient heating element, the flexibility of the heater is limited by the use of such wires. For instance, in Japan 2158323 copper wires are used as the heating elements. With the repeated inflating and deflating that would be experienced with repeated use, it is expected that the redundant load paths associated with the flexing will cause the copper wires to fail, thus losing electrical continuity and heating capability. This [severally] severely limits the life cycle of a flexible heater manufactured with metallic wires. Copper wires disposed in a flexible composition also exhibit very poor adhesion to the surrounding polymer (usually silicon) making uniform and consistent positioning of the wires within the polymer matrix, throughout the expected life cycle of the heater, difficult if not impossible. This can result in the resistance wires being redistributed within the heater in undesired arrangements. While various primers can be employed to increase the bond strength between the polymer matrix and the wires, such primers can further degrade the flexible strength of the wire and limit its malleability, causing premature failure. Additionally, as copper or metallic wires are heated (resistively), their electrical resistance increases proportionately to the temperature increase. In a flexible heater, this means that the amount of power required to achieve a desired temperature must be increased throughout the heating cycle. The relatively high mass of copper or other electrically conductive metal[,] also results in a lag in response time when used as a heating element, thus requiring constant monitoring and adjustment of the power supply.

At page 3, line 3, the paragraph beginning with "Inflatable bladders" has been amended as follows:

> Inflatable bladders that incorporate various heating means have also been used for curing materials impregnated with a thermosetting resin matrix, such as polyester or epoxy based resins. In these resin types, certain chemicals are present that have a detrimental effect on silicone products. Specifically, silicones, when exposed to certain chemicals such as styrene, which is present in many resin systems, and heat, will revert after a limited number of uses [to] into a weak form no longer suitable as an inflation device.

At page 3, line 21, the paragraph beginning with "In view of" has been amended as follows:

> In view of the aforementioned shortcomings associated with the conventional methods of construction and use of flexible, inflatable heaters, there is a strong need for [a] an inflatable heating device containing a heating mechanism that is robust. There is also a strong need for materials that can withstand repeated use in aggressive environments and afford a long life cycle. It will be appreciated that there is also a strong need for an improvement in manufacturing which can reduce production cycle time and capital equipment costs.

At page 4, line 9, the paragraph beginning with "The apparatus" has been amended as follows:

> The apparatus of the present invention is generally characterized by a heating/inflation module having a pressurizable interior and [an] a removably attached heat curable pre-preg. In particular, an elastomeric, seamless composite is provided that includes a heating element disposed within a thermoset resin matrix. The composite is adapted to maintain a consistent temperature profile and an internal air pressure. A first end piece is attached to a first end of the composite and has an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port for communication with a power supply source. A second end piece is attached to a second end of the composite. The apparatus further includes a pre-preg removably attached to an outer surface of the composite. The pre-preg includes a structural fiber matrix supporting a heat curable resin.

At page 4, line 28, the paragraph beginning with "A method" (which continues to page 5, line 11) has been amended as follows:

> A method for repairing a damaged section of a conduit is also disclosed. A pre-preg is removably attached to an outer surface of an elastomeric composite. The pre-preg and composite described herein may be used in this procedure. A heater/inflation module is produced by providing first and second end pieces respectively attached to first and second ends of the composite. The module with the attached pre-preg is installed into the conduit at a damaged location. The module is then inflated to a predetermined internal air pressure to press the pre-preg against an inside surface of the conduit. The pre-preg resin is cured by causing an electrical current to flow in the heating element of the composite to resistively heat the module to a predetermined temperature. The electrical energy supply and thus the curing cycle may be controlled by conventional means such as a programmable logic controller unit. Finally, the module is deflated such as by providing a vacuum source and removed from the conduit, leaving the permanently cured, resin impregnated liner to protect the damaged section of the conduit.

At page 7, line 1, the paragraph beginning with "Figure 9" has been amended as follows:

> Figure 9 is an exploded cross-sectional view of [a] an end portion of the inflatable heating device of the present invention; and[,]

At page 10, line 29, the paragraph beginning with "Once" (which continues to page 11, line 12) has been amended as follows:

> Once the module 210 is in place, an air compressor (not shown) is engaged to direct air into the interior or inflation chamber 102 of the module 210 through its air line 7. The module 210 is brought to a predetermined pressure to expand the composite 205 within the pipe 1. Consequently, the pre-preg 3 is forced against the interior surface of the pipe section 2 and thus conforms to the internal shape of the pipe 1. Electrical current is then flowed from a remote power source (not shown) through the one or more electrical cables 11 to resistively heat the module 210. As noted earlier, the temperature profile exhibited by the module 210 will depend upon the location and density of the conductive fiber braids 201 of the composite 205. The heat given off by the module 210 is maintained to permit the pre-preg resin to exotherm and thus activate the curing phase. Once the pre-preg 3 has fully cured against the damaged pipe section 2, the module 210 is deflated by engaging a remote vacuum source (not shown) to draw a vacuum through the vacuum line 10. The module 210 may then [by] be removed from the repaired pipe 1.

At page 13, line 11, the paragraph beginning with "According" has been amended as follows:

> According to another aspect of the invention, the carbon fibers used as the reinforcement and a means for generating heat in the finished module 210[,] can be used to provide heat to cure the components of the module itself during its manufacture. With the desired lay-up of materials for the module complete, conventional methods are used to consolidate the materials prior to curing, such as wrapping with release tape or web under pressure, enveloping the entire assembly with a membrane or film and drawing a vacuum, or applying a layer of film[,] that, when heated, will shrink and provide compaction. Traditionally, the entire mandrel and composition of the inflatable heater would then be relocated to a curing oven. In the present invention, the carbon fibers are captured at each end and an electric current is introduced. Carbon fibers, being low in mass and with a known conductivity, will rapidly produce heat in a uniform manner. Because the electrical properties of carbon can be readily assumed, precise and uniform heating can be achieved. Also, because the heat source is within the composition of the module, cycle times can be dramatically reduced and excess heat generation is minimized. Energy consumption is far less than traditional methods. This can all be accomplished with the use of an inexpensive power supply as compared to

costly ovens. Because the cure cycle is markedly faster than with an oven or the like, heat transfer to the mandrel is reduced [therefor] thereby providing quicker cool-down [an] and subsequent part removal.

In the Claims:

Claims 1-6 have been amended as follows:

1. (Amended) An inflatable heating device comprising:

a generally cylindrical body having an inner surface and an outer surface, said body including a flexible matrix and a plurality of [carbon] nonmetallic, electrically conductive fibers embedded within said flexible matrix, [said carbon fibers arranged helically and positioned at an angle with respect to the longitudinal axis of said body,] said flexible matrix being cured to a stable elastomeric state by electrical resistive heating of said fibers, [wherein] said body being capable of expanding and returning to an original form.

2. (Amended) The inflatable heating device of claim 1 wherein said flexible matrix comprises one or more materials selected from the group consisting of fluorosilicone and fluorocarbon.

3. (Amended) The inflatable heating device of claim 1 wherein [said flexible matrix comprises fluorocarbon] said fibers comprise one or more materials selected from the group consisting of carbon, nylon, and polyester.

4. (Amended) The inflatable heating device of claim 1 wherein said [carbon] fibers are arranged helically and positioned at an angle of ±45° with respect to [said] the longitudinal axis of said body.

5. (Amended) The inflatable heating device of claim 4 wherein said [carbon] fibers are arranged in one of tows and bundles to provide approximately 50-90% coverage of said body.

6. (Amended) The inflatable heating device of claim 1 wherein said [carbon] fibers [are in the form of] comprise a non-woven tape.